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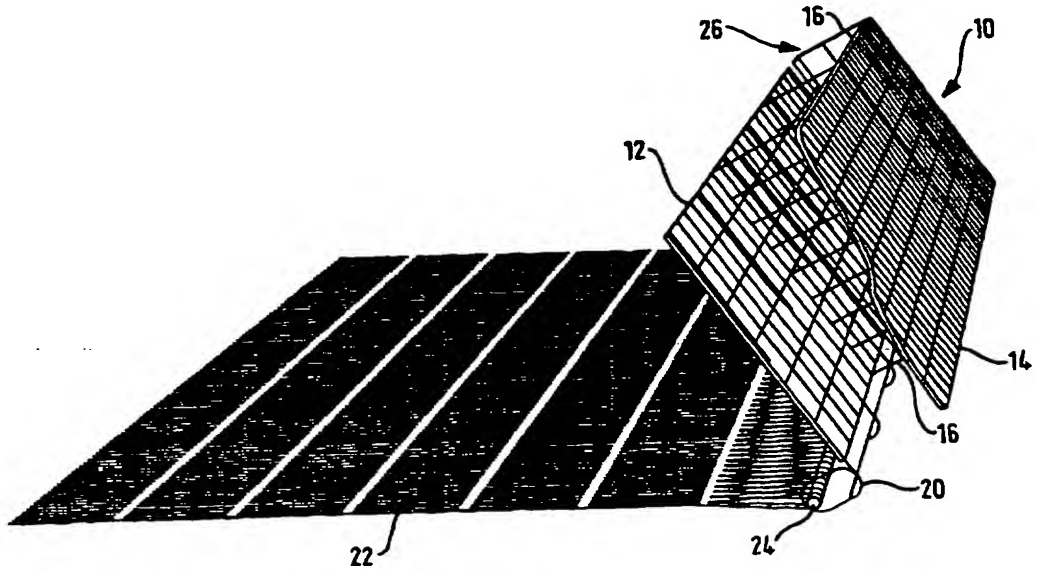

(57) Abstract

The present invention provides for a method and apparatus for supporting vegetative growth on a slope face in which a first layer member (12) can be provided for extending over at least part of the slope, a second layer member (14) can be provided for extending in front of said first layer member (12) and arranged to be spaced therefrom and to define a region (26) therebetween for receiving growing medium and wherein connection means (16) are providing for connecting said first (12) and second (14) layer members together in a manner which allows for the support of the growing medium, and any vegetative growth associated therewith, without prejudicing the mechanical stability and strength of the apparatus.

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METHOD AND APPARATUS FOR SUPPORTING VEGETATIVE GROWTH ON A SLOPE FACE

The present invention relates to a method and apparatus for supporting vegetative growth on a slope face.

The need to provide a formation having a steep slope arises currently in a wide number of instances on construction sites and construction locations, and in particular those associated with transport routes for example railways and motorways. In particular, it is often required to provide an embankment, or cutting, to allow for the construction of the transport link such as a motorway along the required direction, or to allow for the widening of the motorway.

In order to reduce the cost of such construction projects - which costs arise particularly from the amount of land required before the project - it is often necessary to provide embankments or cuttings with relatively steep slopes. Quite often, such steep slopes have to be provided having regard to a geology that does not provide for a naturally supported slope at such required steep angles and it has therefore become necessary to provide for structural support for such steep slopes.

In view of aesthetic considerations, it has also become widely required that the steep slopes be provided with some form of vegetative growth, for example grassing-over or otherwise, so as to reduce the environmental impact of the construction project. Also, in some instances, it has been required to provide some form of suitable vegetative growth, such as grassing-over, of pre-existing slopes which, in view of their nature, might not readily support such vegetative growth.

More recently, a variety of materials, for example geosynthetics, have been used in the constructions of so-called soft-faced reinforced soil embankments. However, even the more recently devised apparatus and methods for the construction of such slopes are particularly disadvantageous in that they have a disadvantageously restricted ability to establish, and sustain, vegetative growth and so, within a relatively short time, the slope begins to look worn, bare and generally spoilt and unpleasant.

Also, known slope-support structures are also disadvantageous in that they employ materials that can degrade if exposed to ultraviolet light and this can severely weaken the supporting characteristics of such known apparatus. Additionally the same materials are particularly vulnerable to fire and are unprotected from fire damage in the event of accidental combustion of vehicles or vegetation.

Further, known support structures prove to be disadvantageously complex and unnecessary expensive to construct and often require additional apparatus such as rising shutters in order to assist their formation. The size of the compaction plant machinery that can be used with known support apparatus when forming the required steep slope is also restricted. Also, particularly when used adjacent motorways and other roadways, the support apparatus is liable to become severely damaged, and dangerously weakened, if a vehicle impacts with the slope-face.

The present invention seeks to provide a method and apparatus for supporting vegetative growth on a slope and which has advantages over known such methods and apparatus.

In accordance with one aspect of the present invention there is provided apparatus for supporting vegetative growth on a slope, comprising a first layer member for extending over at least part of the slope, a second layer member for extending in front of said first layer member and arranged to be spaced therefrom so as to provide a region therebetween for receiving growing medium, connection means for providing connection between said first and second layer members when so spaced, and anchoring means for securing the apparatus to the slope.

The invention is therefore advantageous in that a layer of growing medium can be supported between the first and second layer members without hindering the mechanical strength of the apparatus and which effectively provides a top-soil layer for the slope which is designed to support, establish and sustain vegetative growth. The steep slope embankments can therefore be provided which have dedicated soil systems for facilitating the grassing-over and establishment of vegetation on a steep slope. Also, the invention can of course alternatively provide for a dedicated soil system for establishing vegetation on relatively steep earthwork cut faces in both stable and unstable, generally horticulturally inert, soil materials and which incorporates techniques and features to facilitate the stabilising of otherwise potentially unstable cut faces.

A particular advantage of the present invention is that it serves to separate the structural and horticultural requirements of the slope supporting aspect and allows both to be undertaken and advantageously achieved without detriment to each other.

Preferably, said first layer member comprises a substantially planar member which may also comprise a rigid

member. For example, said first layer member may advantageously comprise a rigid mesh member, and, in any case, the first layer member can be advantageously formed from welded metal wire.

In particular, the first layer member can comprise a lattice member.

It will also be appreciated that the second layer member may be formed with any of the aforementioned features and so can be identical, somewhat similar, or different, in construction, from the first layer member.

In such a manner, the first and second layer members can advantageously be formed in a simple and relatively light weight manner allowing for ease of transportation and construction.

To assist the adoption of the apparatus of the present invention into use with slopes of a variety of length and heights, in that a plurality of first layer members can be arranged to connect at the side, or upper and lower edges thereof to enhance the rigidity of the complete slope supporting structure.

The first layer member may therefore advantageously be provided with engagement formations at a lower, or upper, edge region thereof. In particular, the engagement formations may comprise loop portions provided at the base of the first layer member.

The aforesaid engagement formations can advantageously be arranged for engagement with said anchoring means and, in particular, can be arranged to allow for pivotal engagement between two adjacent first layer member.

The construction of a slope support structure can therefore advantageously be achieved in a relatively simple, safe and quick fashion through the pivoted inter-engagement of each layer in turn of the support structure.

Advantageously, the connecting means may comprise a planar member which can also be rigid perhaps, more particularly, in the form of a rigid mesh.

In order to achieve the same advantages as those that can be exhibited by the first and second layer members, the connecting means may comprise a lattice member formed of cold drawn metal wire.

Advantageously, the connecting means is arranged to define the sides of the region for receiving the growing medium so that, in practice, the connecting means and first and second layer members can advantageously comprise a box-like structure but without a top and bottom wall portion.

In order to form a particularly advantageously rigid structure, said connecting means can be arranged to extend substantially perpendicularly to the first and/or second layer members.

In order to assist the ease of which the structure can be formed, the connecting means can advantageously be connected to the first and/or second layer members and, more particularly, can be pivotally connected thereto.

Further, said apparatus may advantageously comprise supporting means serving to retain said connecting means at a desired angle of extension relative to the first and/or second layer members.

Preferably, the anchoring means is arranged to engage

with the first layer member. The combination of the first layer member, which engages the slope surface, and the anchoring means which extends into the slope formation, therefore provides an advantageously simple and effective support for the second layer member and thus the layer of growing medium that can be located between the first and second layer members.

As mentioned above, the anchoring means can be arranged to be connected to the first layer member by way of a suitable engagement formation formed on the first layer member which may comprise an anchoring loop.

Advantageously, the anchoring means can comprise a soil reinforcement material which, for example, may comprise a geosynthetic material, geotextile, geogrid, or be in the form of a metal wire ladder arrangement or strip.

In another embodiment of the present invention, the anchoring means may comprise a soil nail and the engagement formation formed on the first layer member may comprise a suitable soil nail location site.

According to a further advantage, the first layer member can be arranged with a soil-separation membrane and the second layer member can be provided with a material layer for enhancing vegetation growth such as an appropriate form of matting. Advantageously, the pivotal motion that can be provided for between the second layer member and the connecting means readily allows for the location of any such matting member on the inside surface of the second layer member prior to that second layer member being pivoted so as to close the side walls of the aforementioned box-like structure.

The invention is particularly advantageous in that the

apparatus can be readily flat-packed and simply transported and constructed as and when required in a particularly quick and cost-effective manner.

It will be appreciated that the apparatus can readily be incorporated onto a pre-existing slope surface or, alternatively, can be formed along with the slope so that, for example, the slope-forming material can be readily compacted behind the first layer member during such construction.

According to another aspect of the present invention, there is provided a method of forming a slope surface that can support vegetative growth comprising mounting a first layer member at a location so as to extend in the direction of the slope, connecting a second layer member to said first layer member in a manner so as to extend in front of, and be spaced from, the first layer member, and locating growing medium in the region formed between said first layer member and said second layer member and repeating the aforementioned steps with further respective first and second layer members so as to provide the support along the required length and height of the slope.

Preferably, the connecting means is pivotally connected to the first layer member, and the second layer member is pivotally connected to the connector means so that the first and second layer members can be appropriately mutually located simply by pivoting the connecting means and layer members as required.

Advantageously, one such first layer member can be engaged to another such first layer member located therebelow by pivotal motion therebetween and by virtue of required interlocking between engagement formations of the respective first layer members.

As will be appreciated, the present invention has the particular advantage in that it can provide for a thickness of growing medium, such as top soil, that can prove to be particularly appropriate to the nature of the vegetation required and that the aforesaid growing medium can be applied to the face of any required slope so as to ensure that the vegetative cover can be established and sustained.

Further, the growing medium can also be enhanced by the incorporation of water storing polymers and plant nutrients or soil improvers and this assists in establishing and sustaining the required vegetative cover.

The invention is described further hereinafter by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a panel embodying the present invention;

Fig. 2 is a perspective view of the panel of Fig. 1 but shown in a collapsed state;

Fig. 3 is a perspective view of the panel of Fig. 2 and 3 but in a fully unfolded state;

Fig. 4 is a view similar to that of Fig. 1 showing a plurality of panels during the construction of a required slope; and

Fig. 5 is a view of apparatus similar to that shown in Fig. 5 but according to a further embodiment of the present invention.

In Fig. 1 there is shown a perspective view of a lattice structure 10 embodying the present invention and

which comprises a first planar lattice member 12 and a second planar metal lattice member 14 spaced from the first lattice member 12 and extending a plane substantially perpendicular to the plane of the first lattice member 12. A plurality of lattice connection members 16 extend between the first 12 and second 14 lattice members and serves to retain the second lattice member 14 in the required space relationship relative to the first lattice member 12. In the case of Soil Nail System to be described later with reference to Fig. 5, connectors are extended to link top and bottom layers of the lattice structure.

As will be appreciated from the further discussion below, the first 12 and second 14 lattice members and the respective lattice connector members 16 serve to form a generally box-like structure having walls formed of a metal lattice but having open top and bottom ends.

Connecting loops 20, as will be appreciated from the discussion below, are arranged to engage with the upper edge portion of a first lattice structure located below that illustrated in Fig. 1. Also, the connector loop 20 forms an anchorage point from which an anchorage member 22 in the form of a geosynthetic soil reinforcement material layer, extends and which is secured to the connector group 20 by means of a soil-reinforcement connecting bar 24 or alternatively to a metal mesh ladder reinforcement system through a similar connector loop 20 and using the connecting bar 24.

With regard to the overall appearance of the lattice structure 10, it will be appreciated that provided a rectilinear channel region 26 which extends downwardly in the structure 10 and which is bounded by the first 12 and second 14 lattice members and mutually opposite lattice connector members 16.

Referring now to Figs. 2, 3 and 4, the construction of the lattice structure 10 illustrated in Fig. 1 is described further.

In Fig. 2, the lattice structure 10 is shown in its collapsed state which is at a state in which the structure 10 can be transported and delivered to the required site in a particularly cost-effective manner. Each of the lattice connector members 16 are folded down over the first lattice member 12, and the second lattice member 14 is likewise folded down to cover the lattice connector members 16 and the first lattice member 12.

In Fig. 3, the lattice structure 10 is illustrated once having had the lattice connector members 16 pivoted into a position in which they extend in a perpendicular manner from the first lattice member 12, and in which the second lattice member 14 has been pivoted in the same direction as the connectors 16 to form the box like lattice structure 10.

It will be appreciated that, in order to arrive at the particular configuration of the lattice structure 10 as shown in Fig. 3 from that as shown in Fig. 2, the lattice connector members 16 have been pivoted in the direction of arrows A.

Wire ties 28 are provided and serve to retain the lattice connector members 16 in a position which they extend perpendicular to the first lattice member 12. Also, the pivotal motion in the direction of arrow A is achieved by the provision of respective hinge means 30, 32 at the junction between the lattice connector members 16 and the first lattice member 12, and the second lattice member 14 and the lattice connector members 16 respectively.

A matting material is fixed to the inside of the second lattice member 14 prior to the introduction of the growing medium for example appropriate top soil, into the channel region 26 shown in Fig. 1.

The first and second lattice members 12, 14 can advantageously be connected together by means of said connector members 16 in a manner which allows for pivotal motion of said connector members 16 from a flat-packed form to a fully assembled form as illustrated in Fig. 3.

Referring now to Fig. 4, there is provided a schematic drawing illustrating the use of one particular embodiment of the present invention. As will be appreciated, Fig. 4 shows a lattice structure corresponding to the structure of Figs. 1-3, defining an outer surface region of a slope for an embankment which is under formation.

The current surface 34 of the slope material 36 forming the actual slope is illustrated and is provided that the height which is almost equal to twice the height of the first lattice member 12. Thus, according to the state of formation of the slope as shown in Fig. 4, a slope surface is being formed and has so far reached the height of three stacked lattice structures 10 which are indicated by the three respective connecting loops 20 illustrated in the drawings. The lower two of the first lattice members 12 have had the slope material 36 compacted therebehind and, at each appropriate stage, have had the respective anchorage material layers 22 extend back into the slope material 36 during its formation. Upon reaching the part of the surface 34 now evident in Fig. 4, a third lattice structure 10 has been stacked on the previous lattice structures and this can be readily achieved by workmen supported on the surface 34 and by simply pivotally connecting the connector loop 20 associated with the third

lattice structure 10 into appropriate engagement with an upper formation of the first lattice member 12 of the lattice structure upon which it is to be stacked. Once in the position as shown in Fig. 4, further slope material can be introduced, i.e. onto the surface 34 as shown in Fig. 4, and compacted behind the first lattice member 12 so as to increase the height of the slope material. If the total height of the slope is to be greater than that illustrated in Fig. 4, then the process of stacking further lattice structures 10, in the pivotal manner indicated, can be followed until the slope reaches the required height.

As each lattice structure 10 is stacked above the one below, the channel 26 see Fig. 1 formed between the first 12 and centre 14 lattice members of each lattice structure 10 is filled with an appropriate growing medium 38 for example a suitable top soil. As mentioned before with reference to Fig. 3, the inner surface of the second lattice member 14 has previously been lined with a matting material which can assist in retaining the growing medium 38 in the channel region 26.

As will then be appreciated, the required vegetative cover introduced to the surface of the slope now defined by the second lattice member 14 can advantageously be established, and sustained, by the appropriate growing medium comprising the layer 38 of growing medium now found in the channel region 26, while such growing medium is retained between the first 12 and second 14 lattice members. Since the vegetative cover does not need to take hold on the compacted soil material 36 located behind the lattice structure 10 embodying the present invention, the vegetative cover does not suffer any disadvantages and, once established, can be readily sustained.

The particular box-like structure of the present

invention is also advantageous in that a suitably rigid and mechanically strong lattice structure can be provided which merely requires anchorage material means 22 to extend into the body of the slope in order to achieve the required mechanical strength.

Since the embodiment of the present invention illustrated in the drawings is formed from planar lattice members, the angle at which the slope is to extend can be determined solely from on-site considerations rather than from factors such as the shape and relative dimensions of the lattice structure which is often the case with prior art structures.

Further, in view of the rigid box-like structure, a separate structure, such as rising shutters, is not required during the construction of the slope surface and, in particular, during compaction of the reinforced slope material 36. The use of larger compaction plant machinery and is otherwise known can therefore be used with the present invention. As will also be appreciated from Figs. 1-4, the lattice structure 10 is installed above the level of the required compaction operations and this forms an advantageous safety barrier for the on-site personnel.

Also, the lattice structure 10 is installed from the embankment side of the slope face and, by appropriate use of the connecting loop 20, hinges into place in front of the personnel and so protection is maintained for other site operatives during the construction of the reinforced soil mass.

The use of the present invention therefore allows for two particular regions to be formed in the embankment structure illustrated in which the main body of the embankment can be formed from a reinforced soil mass, or

some other in or connectedly inert material, which is suitably solidly compacted, while an outer layer of the surface region can be formed of a material appropriate to the required vegetative cover.

Further, the present invention does not require the incorporation of geosynthetic soil reinforcement materials and so ultraviolet degradation is not suffered by the structure of the present invention. Degradation due to raised temperatures can also arise with geosynthetic soil reinforcement materials and so the present invention is also advantageous in avoiding such further cause of degradation of the structure.

Further, while the structural support to the face of the reinforced mass is provided by the first lattice member 12, the layer of growing medium within the lattice structure 10 provides corrosion protection insofar as direct exposure to corrosive elements can be advantageously avoided. Also, if vehicle impact occurs with the lattice structure 10 it is merely the second lattice member 14, and the growing medium layer 38 that suffer damage and the mechanical integrity of the slope-supporting lattice structure remains intact.

Finally, the interlocking action between upwardly adjacent pairs of lattice structures 10 which is advantageously achieved by the engagement formations mentioned before, provides for positive engagement between the elements forming the upper part of the complete structure and this therefore provides an effective structural restraint against pressures within the slope structure 36 during, and after, compaction and construction.

Turning now to Fig. 5, there is illustrated a further

embodiment of the present invention.

The lattice structure 110 is somewhat similar to the lattice structure illustrated with reference to Figs. 1-4, in that it comprises a first lattice member 112, a second lattice member 114 and a plurality of lattice connector members 116 extending between the first 112 and second 114 lattice members.

Again, a suitable growing medium, for example top soil 138, is introduced into the channel 126 formed between the first 112 and second 114 lattice members and serves to support the required vegetative cover. However, the embodiment of the present invention illustrated with reference to Fig. 5 differs from that illustrated with reference to Figs. 1-4 in that soil nail 122, which engage the first lattice member 112 by means of a soil nail header plate 124, are employed for anchoring the lattice structure 110 to the slope material.

The embodiment of the present invention illustrated with reference to Fig. 5 is particularly advantageous for use in the situation where the apparatus of the present invention is to be provided on the face of a pre-existing slope. Thus, pre-existing slope formed of a generally organically inert material can advantageously be provided with a covering of suitable top soil material 138 for establishing and supporting vegetative cover. Additionally the use of soil nails serves to strengthen an existing soil slope.

Although not restricted to the foregoing details, the illustrated embodiment of the present is formed from panels of rigid mesh combining to form a box-like or cage-like structure and to the mesh is itself formed from cold drawn steel wire which has been electrically welded at each

intersection and coated in benzinal, galvanize or PVC. The in-filled growing medium serving to form a face of an engineering reinforced soiled system can comprise top soil with soil additives such as a water holding polymer, alginate and soil ameliorants. Also, seeded matting, or mulchmat, can be secured to the inside face of the second lattice member 14 and this provides for a grassed-over finish to the slope surface in the former case, and a landscaped planted face in the case of the latter.

The embodiment illustrated with reference to Fig. 5 has a particular advantage in that the apparatus prevents so-called "slumping" around the soil nail head which is disadvantageously experienced with structures known in the prior art and, in particular, those which employ the use of geosynthetic materials.

As mentioned hereinbefore, the apparatus of the present invention provides for a modular panel lattice structure formed of panel sections which can be pre-manufactured with hinges for easy on-site assembly and which can advantageously be stored and transported in "flat-packed" form.

Also, a geosynthetic separation membrane can be installed on the rear surface of the first lattice member 12 so as to prevent contamination of the growing medium and/or the reinforced soil.

The invention is not restricted to the details of the foregoing embodiments. For example, the lattice structure 10 can be anchored to the slope material by any appropriate means and the lattice structure itself can be arranged to be formed in any particular manner, and with any required number of connecting members extending between the first and second lattice members. As such, the lattice structure

10 can be formed on site through the appropriate interconnection of the required lattice panels rather than the near pivotal motion required of the illustrated embodiments.

Also, the lattice members can be formed of any particular material which serve to provide the channel for receiving the growing medium that is appropriate to the particular environmental conditions. For example, given particular conditions, the first and second layer members need not be planar, or indeed rigid, in form.

It will be appreciated that other modifications and variations may be made to the embodiments described and illustrated within the scope of the present application.

CLAIMS

1. Apparatus for supporting vegetative growth on a slope, comprising a first layer member for extending over at least part of the slope, a second layer member for extending in front of said first layer member and arranged to be spaced therefrom so as to provide a region therebetween for receiving growing medium, connection means for providing connection between said first and second layer members when so spaced and anchoring means for securing the apparatus to the slope.

2. Apparatus as claimed in Claim 1, wherein said first layer member comprises a substantially planar member.

3. Apparatus as claimed in Claim 2, wherein said first layer member comprises a rigid mesh member.

4. Apparatus as claimed in Claim 1, 2 or 3, wherein said first layer member comprises a lattice member.

5. Apparatus as claimed in any one of Claim 1 to 4, wherein said second layer member comprises a substantially planar member.

6. Apparatus as claimed in Claim 5, wherein said second layer comprises a rigid mesh member.

7. Apparatus as claimed in any one of the preceding claims, wherein said second layer member comprises a lattice member.

8. Apparatus as claimed in any one of the preceding claims, wherein said first layer member includes an engagement formation for engagement with a further first layer member.

9. Apparatus as claimed in Claim 8, wherein said engagement formation comprises a loop portion provided at the periphery of the first layer member.

10. Apparatus as claimed in Claim 8 or 9, wherein said engagement formation is arranged for engagement with said anchoring means.

11. Apparatus as claimed in any one of the preceding claims, wherein said connection means comprises a planar member.

12. Apparatus as claimed in Claim 11, wherein said connection means is formed of the same material as said first and second layer members.

13. Apparatus as claimed in any one of the preceding claims, wherein said connection means is arranged to define the sides of said region for receiving the growing medium.

14. Apparatus as claimed in Claim 13, wherein said connection means is arranged to extend substantially perpendicularly to the first and/or second layer members.

15. Apparatus as claimed in any one of the preceding claims, wherein said connecting means is pivotally connected to said first and/or second layer members.

16. Apparatus as claimed in any one of the preceding claims, wherein said anchoring means is formed of soil reinforcement material.

17. Apparatus as claimed in any one of Claims 1 to 15, wherein said anchoring means comprises a soil nail.

18. Apparatus as claimed in any one of the preceding

claims, wherein said first layer member is arranged with a soil-separation membrane and the second layer member is provided with a material layer for enhancing vegetation growth.

19. A method of forming a slope surface that can support vegetative growth comprising the steps of mounting a first layer member at a location so as to extend in the direction of the slope, connecting a second layer member to said first layer member in a manner so as to extend in front of, and be spaced from, the first layer member, and locating growing medium in the region formed between said first layer member and said second layer member and repeating the aforementioned steps with further respective first and second layer members so as to provide the support along the required length and height of the slope.

20. A method as claimed in Claim 19, wherein said connecting means is pivotally connected to the first layer member, and the second layer member is pivotally connected to the connector means so that the first and second layer members can be appropriately mutually located simply by pivoting the connecting means and layer members as required from a folded state to an assembled state.

21. A method as claimed in Claim 20, wherein said first layer member is engaged to another first layer member by pivotal motion therebetween and so as to achieve interlocking between an engagement formation of one of said first layer members and another of said first layer members.

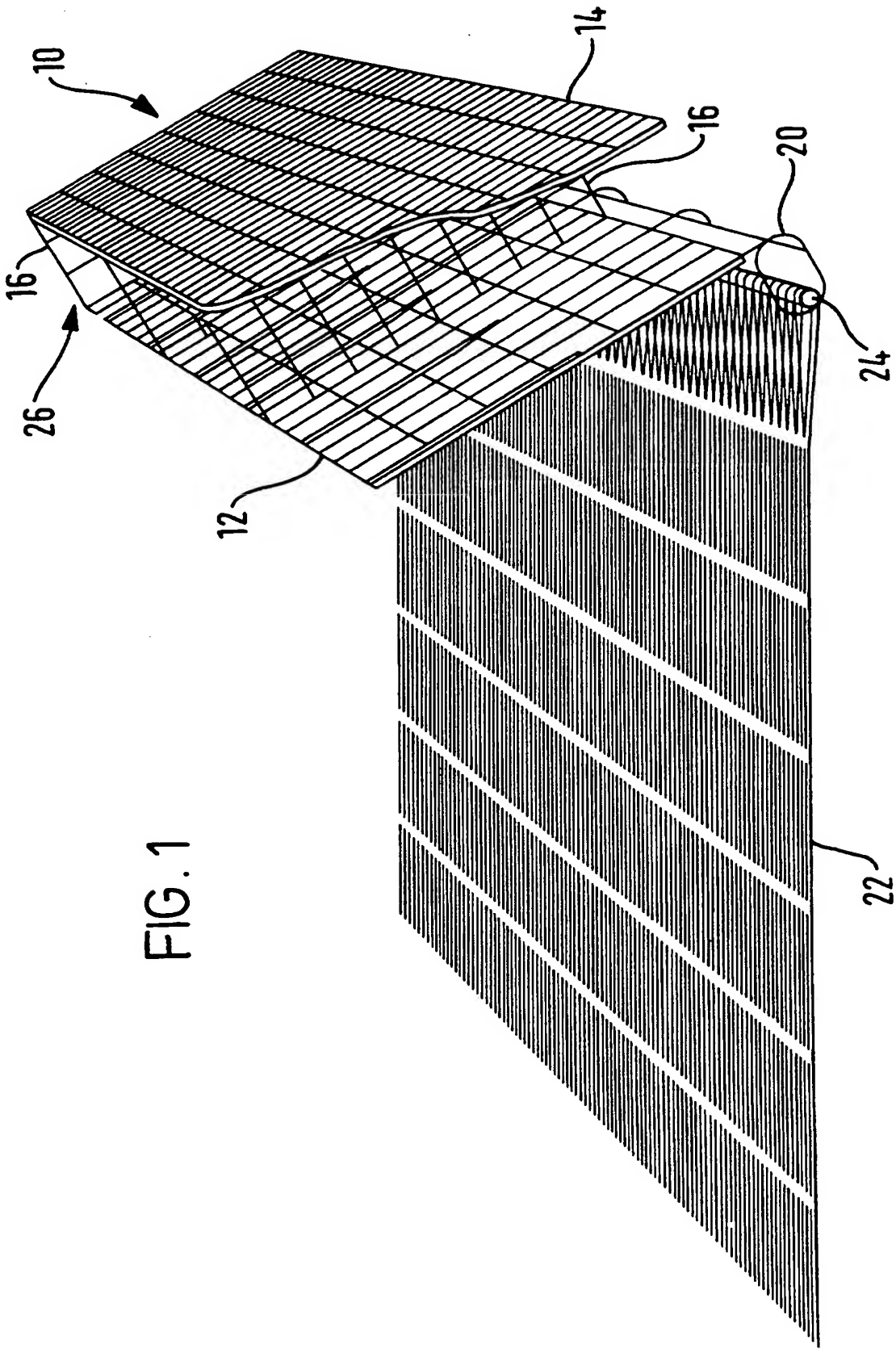


FIG. 1

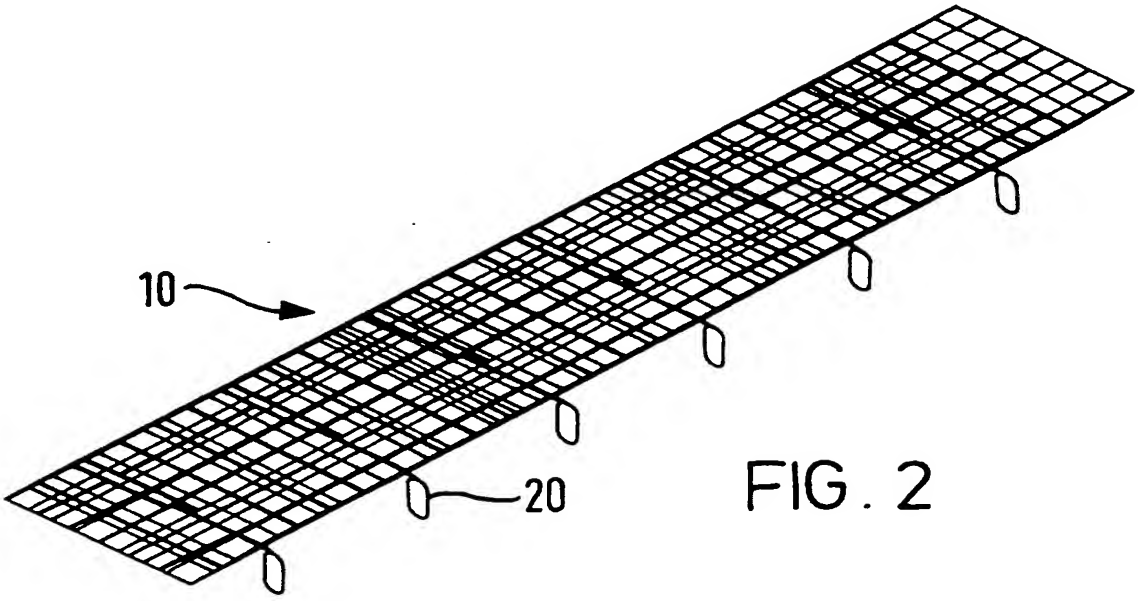


FIG. 2

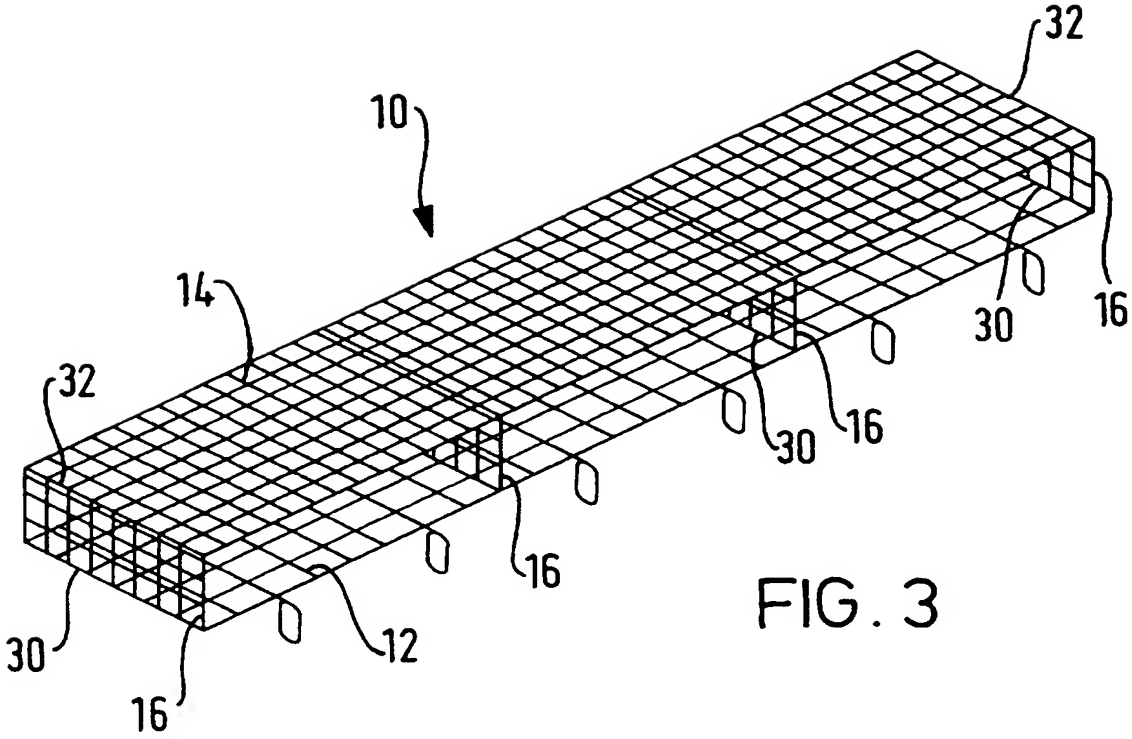


FIG. 3

FIG. 4

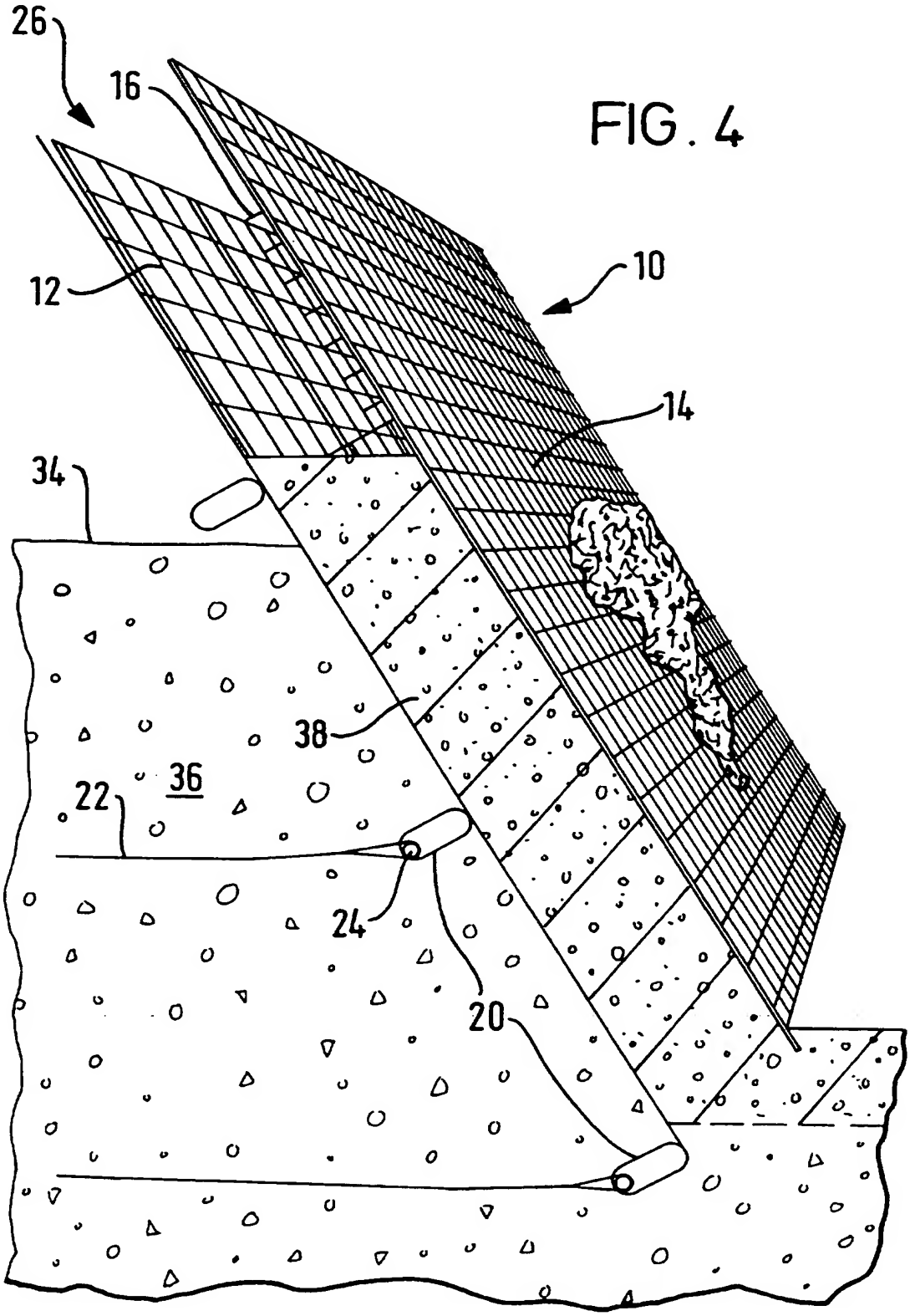
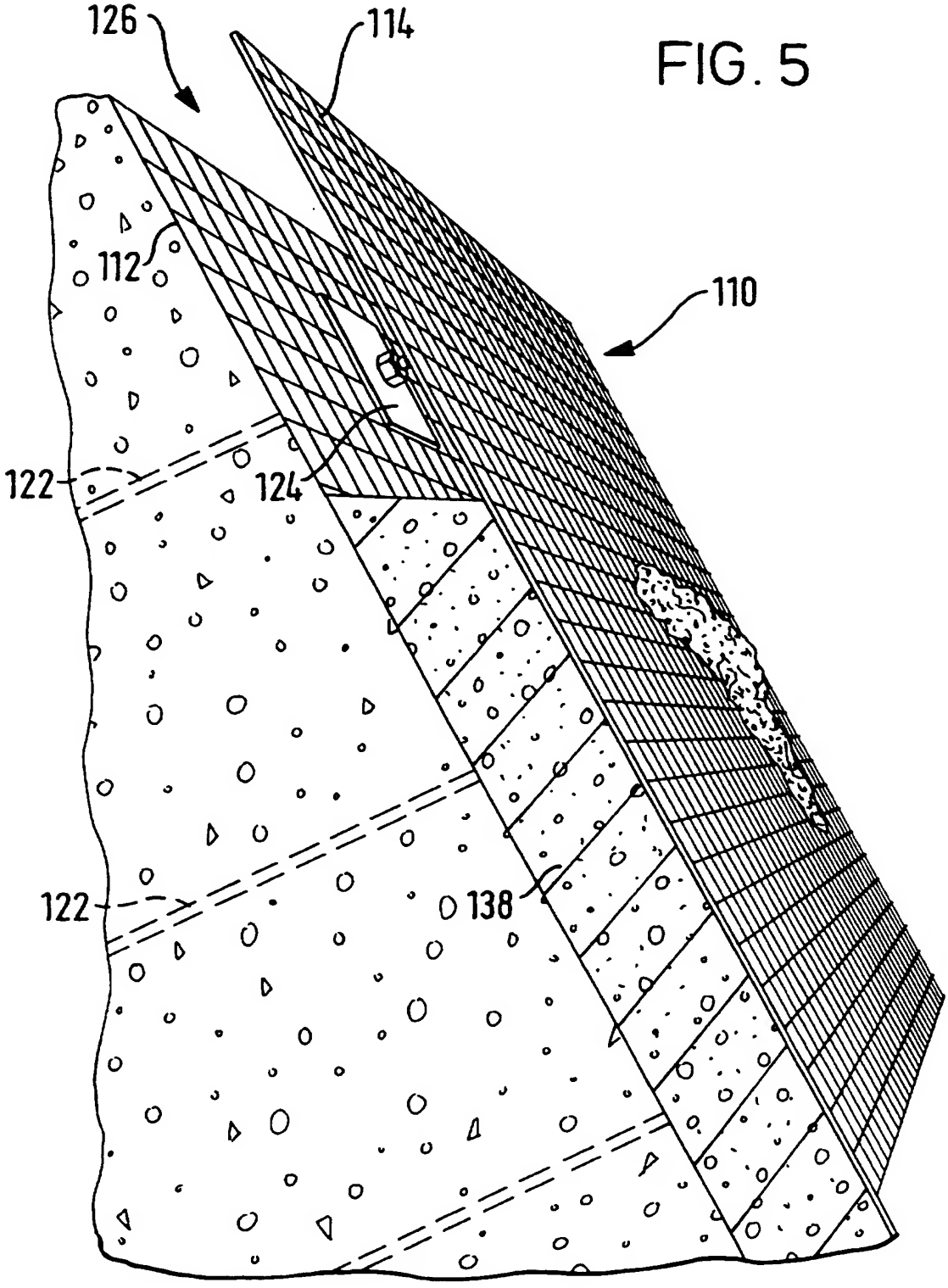


FIG. 5



INTERNATIONAL SEARCH REPORT

Inter[illegible]pplication No
PCT/GB 95/02692

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E02D17/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E02D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 437 171 (EBERLE LANDSCHAFTSBAU AG) 17 July 1991	1,2,4,5, 7,15, 17-19
Y	see column 2, line 48 - column 5, line 55; figures	3,6
A	---	16,20
X	CONSTRUCTION WEEKLY, vol. 3, no. 15, 17 April 1991 page 31 XP 000223023 'GRASSY SLOPE PLEASES PLANNERS'	1,2,4,5, 7,16,17, 19
A	---	18
X	PATENT ABSTRACTS OF JAPAN vol. 007 no. 025 (M-190) ,2 February 1983 & JP,A,57 180719 (TOUKOU KENSETSU KK) 6 November 1982,	1,2,4,5, 7
A	see abstract	3,6,17

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 February 1996	04. 03. 96
Name and mailing address of the ISA	**Authorized officer**
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Blommaert, S

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 95/02692

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	AT,A,320 529 (SCHIECHTL H OE;WEBER H OE) 10 February 1975 see the whole document	1,5 3,6 2,4,19
X A	EP,A,0 391 857 (FEHLMANN GRUNDWASSERBAUTEN AG) 10 October 1990 see the whole document	1,17,19 2-7,16, 18
A	US,A,4 117 686 (HILFIKER WILLIAM K) 3 October 1978 see figures	8-10
A	US,A,5 076 735 (HILFIKER WILLIAM K) 31 December 1991 see figures	11-14
A	FR,A,2 591 064 (RHONE POULENC FIBRES) 12 June 1987	

1

INTERNATIONAL SEARCH REPORT

...formation on patent family members

Inter... Application No
PCT/GB 95/02692

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0437171	17-07-91	AT-T- 126304 DE-D- 59009506	15-08-95 14-09-95
AT-A-320529	10-02-75	NONE	
EP-A-0391857	10-10-90	CH-A- 681376	15-03-93
US-A-4117686	03-10-78	NONE	
US-A-5076735	31-12-91	NONE	
FR-A-2591064	12-06-87	NONE	